

FIG. 5, again similar to FIG. 3, corresponds to an exposure of 24 hours to steam at 500° C. and gives a representation of nodular corrosion; and

FIG. 6 is a graph indicating limits of zones in which the resistance to corrosion in different conditions is particularly favorable, making it clear that there is a particular interest in ranges 0.2–0.3% Sn and 0.15–0.3 Fe as regards resistance to corrosion.

FIGS. 1 and 2 indicate that there is no significant enhancement of the resistance to corrosion in lithium containing water beyond about 0.6% Sn and 0.2% Fe.

FIGS. 3 and 4 show there is an interest in an iron content higher than 0.2%, for enhancing the resistance to corrosion in water steam at 400° C. and 415° C. and reducing the undesirable effect of a high Sn content. Such Figures also indicate that the favorable results which are found for an alloy according to the invention are lost if there is a low tin content or no tin.

Last, FIG. 5 indicates that there is a progressive loss of the resistance to nodular corrosion when the tin content increases, without significant improvement of the characteristics by adding iron. FIG. 5 shows that beyond a tin content of 0.6%, corrosion became faster and it also shows that, for an acceptable tin content, corrosion is faster if the iron content increases beyond about 0.3%.

From a general consideration of all results, a composition range which is favorable regarding corrosion is defined by the three curves indicated in FIG. 6. Curve A limits a zone of interest as regards resistance in water at 360° C. with a 70 ppm lithium content i.e. under conditions which are more severe than those which prevail in a reactor, as regards the lithium content. Curve B limits a zone in which there is satisfactory resistance in lithium containing steam at a temperature slightly beyond 400° C. Last, curve C approximately corresponds to a limit of the acceptable contents as regards nodular corrosion resistance, in water steam at 500° C.

It is however possible to exceed the above indicated zone when some types of corrosion are not likely to occur.

We claim:

1. A tube of zirconium-base alloy for constituting all or the outside portion of cladding for a nuclear fuel rod or of a guide tube for a nuclear fuel assembly, made of a zirconium-base alloy containing, by weight, 0.8% to 1.8% niobium, 0.2% to 0.6% tin, and 0.02% to 0.4% iron, plus inevitable impurities, and having a carbon content controlled to lie in the range 30 ppm to 180 ppm, a silicon content in the range 10 ppm to 120 ppm, and an oxygen content in the range 600 ppm to 1800 ppm.

2. A tube according to claim 1, wherein the alloy is in recrystallized state.

3. A tube according to claim 1, wherein the alloy is in relaxed state.

4. A tube according to claim 1, wherein the alloy has set contents: 0.9% to 1.1% niobium, 0.25% to 0.35% tin, and 0.2% to 0.3% iron.

5. A method of manufacturing a tube according to claim 1, including the following steps of:

making a bar of an alloy containing 0.8% to 1.8% niobium, 0.2% to 0.6% tin, and 0.02% to 0.4% iron; after heating in the bar to a temperature in the range 1000° C. to 1200° C., quenching the bar in water;

drawing the bar into a blank after heating to a temperature in the range 600° C. to 800° C.;

annealing the drawn blank at a temperature in the range 590° C. to 650° C.; and

cold rolling the annealed blank in at least four passes into a tube, with intermediate heat treatments at temperatures in the range 560° C. to 620° C.

6. A method according to claim 5, wherein the rolling passes are performed on tubes having increasing recrystallization ratios.

7. A method according to claim 5, further including a recrystallizing final heat treatment step at a temperature in the range 560° C. to 620° C.

8. A method according to claim 5, further including a strain relieving final heat treatment step at a temperature in the range from about 470° C. to 500° C.

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